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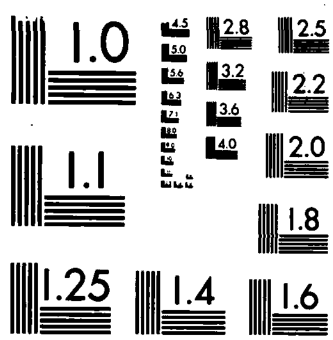
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PRIVATE ECONOMIC STOCKPILING
AS AN ALTERNATIVE TO
MINERAL IMPORT VULNERABILITY

THESIS

Robert K. Hutto
Captain, USAF

AFIT/GLM/LSP/85S-38

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
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Master of Science in Logistics Management

Robert K. Hutto, B.B.A.
Captain, USAF

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Robert K. Hutto

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Abstract

The defense industry and essential civilian industry of the United States has grown dangerously dependent on uncertain foreign sources of strategic and critical materials. The corresponding increase in vulnerability to shortages or cessations in supply has generated new interest in alternatives for reducing the vulnerability.

As prime users of many of the strategic and critical materials, 30 of the top 100 Department of Defense contractors for fiscal year 1984 were surveyed on their acceptance of creating privately owned and operated economic stockpiles as one alternative for reducing imported mineral vulnerability. The contractors were also asked to rank, in order of preference, seven possible financial incentive programs that might induce defense contractors to consider establishing private stockpiles of strategic and critical materials.

Results from personal interviews with Material Managers of the selected defense contractors shows that the private stockpiling alternative is not considered acceptable by the sample of contractors surveyed. The cost associated with developing and holding excess inventories was cited as the prohibitive factor.

Of the seven incentive programs offered, use of "guaranteed multi-year procurement contracts" was more influential to the contractors than were the direct financial incentives offered. Stabilized procurement and production planning was emphasized by the contractors.

Recommendations from this study are that Congress should not rely on the private stockpiling alternative as a means of reducing import vulnerability. Defense contractors would be much more receptive to establishing private stockpiles if Congress and the Department of Defense used guaranteed multi-year contracting in conjunction with one of the preferred incentive programs. The Department of Defense must emphasize to Congress the potential benefits in coupling long-range procurement with specific short-range investment incentives as a method of assuring availability of increasingly important strategic and critical materials.

PRIVATE ECONOMIC STOCKPILING AS AN ALTERNATIVE TO MINERAL IMPORT VULNERABILITY

I. Introduction

General Issue

The United States is a minerals-dependent nation. An estimated 24 of 29 materials considered vital to our economy are imported from foreign sources with uncertain ties to the United States. In all areas of design research--from jet engines and turbines to batteries and stainless steel--engineers are asking themselves the same question: "How can we do without" (1:44)? Numerous Congressional committees have recently expressed concerns about the national security implications of U.S. dependence on and vulnerability to imported minerals supplies. The Strategic and Critical Materials Stockpiling Revision Act of 1979 consolidated all inventories collected under authority of the 1951 Materials Policy Commission and subsequent legislation into one National Defense Stockpile (NDS) (2:5-9). The NDS is intended to insure the availability of strategic minerals to meet military, industrial and essential civilian needs during a national emergency. The U.S. is dependent on the import of foreign minerals to support requirements of the

defense industry as well as the stock levels of 29 of 35 minerals in the NDS (2:5). Dependence is defined as the percentage of U. S. consumption provided by foreign import. Vulnerability includes factors such as availability of minerals, availability of supply alternatives and the likelihood of circumstances that could result in curtailment or cessation of supply (2:2).

Specific Problem

The U. S. has a number of options to reduce the dependence on and vulnerability to imported minerals. Methods available to Congress to reduce vulnerability include: a) increase the NDS quantities b) subsidize domestic production c) diversify sources of supply d) intensify metals and materials research or e) build economic stockpiles. It is the last option on which this paper focuses. Several foreign nations have both strategic and economic (private) stockpiles subsidized by government funds. A variety of tax and credit incentives are used to induce foreign private users of strategic minerals to hold larger than normal inventories. As a possible alternative to reduce vulnerability, this raises the question, "What types of incentives are required by U. S. defense contractors to carry excessive stocks of critical materials dedicated solely to defense programs?"

Definitions

Certain terms, as used in this thesis, are defined as follows:

a. "Materials" refers to substances, including minerals, of current or potential use that will be needed to supply industry, the military and essential civilian needs of the U. S. in the production of goods or services. This generally excludes food and energy fuels.

b. "Strategic and critical materials" means materials that would be needed to supply the military, industry and essential civilian needs of the United States during a national emergency and are not found or produced in the U. S. in sufficient quantities to meet such needs.

c. "National emergency" means a general declaration of emergency with respect to the national defense made by the President or by the Congress.

Background

The National Defense Stockpile (NDS) is the cornerstone of the United States mineral policy (2:7). The origins of the NDS can be traced to before World War II. To counter the threat of loss of vital minerals and materials imports as a result of Japanese influence in Asia and the possibility of war in Europe, the Strategic Materials Act (P. L. 76-117) was passed by Congress in 1939. The Act authorized the Secretaries of War, Navy and the Interior to determine which and in what quantity and quality materials

should be purchased to meet defense requirements. At that time, 39 materials were considered critical or strategic. Purchases began slowly and were often superseded by more urgent war requirements and mobilization needs (3:57).

In 1946, Congress passed the Strategic and Critical Materials Stock Piling Act (P. L. 79-520). The objectives were aimed at increasing our emergency preparedness by developing domestic sources of supply where possible and by creating stockpiles of materials which were not present in sufficient quantities in the United States (3:58).

The Korean War effort led to another period of material shortages and focused the attention of Congress on emergency preparedness. The Defense Production Act of 1950 (P. L. 81-774) was passed in an effort to improve the readiness of the Nation's industrial base and prepare for national defense mobilization programs (3:60). The Act was originally written to expire in 1952; however, a total of 31 public law extensions have kept three of the original seven titles active as a part of major legislation in the national defense program (3:61,63). The three sections of the original act that remain are:

1. Title I: Establishes the Defense materials and facilities system of priorities and allocations

2. Title III: Provides for specific financial assistance and incentives for improvements to and expansion of production capacity and supplies through loans, loan guarantees, loss sharing agreements, and price supports.

3. Title VII: Provides protection from violation of anti-trust laws for companies or individuals that voluntarily enter business agreements to meet urgent defense needs. It also provides for special training to executive and professional personnel for government service in the event of a national emergency (3:60).

The Defense Production Act of 1950 was amended on 30 June, 1980 (Energy Security Act, P. L. 96-294) to include energy resources as strategic and critical materials essential to national defense (3:63).

In 1951, President Truman's Materials Policy Commission, known as the Paley Commission, agreed that the strategic stockpile be maintained solely to meet U. S. requirements during a military emergency. It further sanctioned the reliance on the free market economy (low cost foreign sources) to support the minerals requirements of the civilian industry. In effect, the commission established the long-standing U. S. philosophy of rejecting a minerals self-sufficiency (2:9).

The Mining and Minerals Policy Act of 1970 (P. L. 91-631) was deemed necessary due to the growing concern over decreasing productivity of the domestic mining industry. Projections showed a depletion of high grade domestic resources, increasing production costs and increasing competition from holders of low-cost, higher grade foreign deposits. Despite an ever increasing worldwide demand, there was a lack of long-range planning and production objectives in the domestic mining and minerals

industries (3:66). The Act established a Federal government responsibility within the Department of the Interior to foster and encourage economic development of a stable mining and minerals resources industry. During the 1970's, however, the Department did little to follow the directives of the Act and failed to establish a national minerals policy (3:68). In addition to the decline of domestic production capacity, these years were marked by a great many fluctuations in stockpile policy with each change of Presidential administration. The stockpile often became a tool to help relieve budgetary strains. In 1973, President Nixon reduced the NDS stockpile goal requirements from three years to one year. The NDS goals were originally established to support a five-year conflict. Earlier in 1958, the stockage goals were reduced to reflect planning for a three-year conflict. As a result, these changes substantially reduced quantities of materials required in the stockpile. The 1975 Subcommittee on Seapower and Strategic and Critical Materials of the House Armed Services Committee, voted to authorize no further disposals of stockpile materials until a new policy study was conducted. It also insisted that stockpile planning be based on a three-year emergency. In 1976 the Ford Administration proposed a new long-range program of acquisitions and disposals and subsequently increased goals for 72 of 93 stockpiled materials (3:234). The Carter Administration

suspended all defense related stockpile acquisitions and disposals until completion of its own policy review. The Administration announced its agreement with the Ford Administration's policy to continue to stockpile strategic materials based on the three year requirement (3:235).

Subsequently, Congress passed the Strategic and Critical Materials Stock Piling Revision Act of 1979 (P. L. 96-41). It was a major step toward formulating a national policy on stockpiling that was independent of economic or budgetary pressures (4:22). The major provisions of the Act specify that:

1. Stockpiles are solely for the common defense of the United States and would not be used as a means of controlling or influencing commodity prices.

2. Stockpile goals are to be established to meet the three year requirement.

3. The President is the individual responsible for managing the stockpile (3:69).

The Act also consolidated three stockpiles created under authority of the 1939 Strategic and Critical Materials Stock Piling Act, the Defense Production Act of 1950 and the Agricultural Trade Development and Assistance Act of 1954. All critical materials are now centrally managed under the NDS. All acquisitions and disposals must be authorized by law, thus allowing for more effective congressional control (3:242).

Under the authority of P. L. 96-41 the President determines which materials are strategic and critical and

the quantity and quality of each material to be acquired. The President has delegated responsibility for stockpile planning and oversight activities to the Director of the Federal Emergency Management Agency (FEMA). The Office of Plans and Preparedness of that agency is responsible for developing policy guidelines for stockpiling strategic materials and for periodically reviewing stockpile goals. Specific management functions have been delegated to the administrator of the General Services Administration (GSA) and the Federal Property Resources Service of GSA. The management functions include buying, selling, storage, security, maintenance, rotation, and refining or processing of materials (3:235).

Research Objective

The first objective of this research was to determine if major DoD contractors consider private economic stockpiling as a method of reducing mineral import vulnerability. The second objective was to determine what types of incentive or incentives would induce defense contractors to consider establishing a private stockpile of strategic and critical materials dedicated solely to defense programs.

Investigative Questions

1. Is the economic stockpile an acceptable alternative to major DoD contractors to reduce vulnerability to mineral shortages?

2. What type of incentives are required by U. S. defense contractors to carry excessive stocks of critical materials dedicated solely to defense programs?

3. Are there any perceived advantages/disadvantages to creating private economic stockpiles?

<u>Summary</u>

The National Defense Stockpile was created due to the questionable security of essential mineral and material supplies during the years just prior to World War II. The objective of the stockpile was to reduce the vulnerability of our essential defense and civilian industries to cessations of or reductions in strategic and critical materials needed most during national emergencies. Since 1939, control and management of the stockpile has rested solely with the Federal Government. This research was designed to determine if private stockpiling by major Department of Defense contractors is considered as an acceptable alternative for reducing vulnerability to imported minerals and materials. The secondary objective concerns what, if any, financial incentives could be used to induce contractors to create private stockpiles.

Chapter II provides a detailed look at the current status of the NDS. Also included are some contemporary views on the growing dependence on and vulnerability to imported minerals. Stockpiling alternatives are reviewed, including the economic stockpiling policies of selected foreign governments.

Chapter III presents the methodology used to collect data significant to this research.

Chapter IV discusses the data analysis and findings of the personal interviews conducted by the researcher.

Chapter V provides a summary of the research and discusses the conclusions drawn from the analysis of findings. Recommendations based on those conclusions are presented as well as are recommendations for further study.

II. Literature Review

Current Legislation

The legislative activity through 1979 brought needed improvements to specific areas of stockpile management. In an effort to directly address the deficiencies of a national materials policy, Congress passed the National Materials and Minerals Policy, Research and Development Act of 1980 (P. L. 96-479). The purpose of the Act was:

> to provide an adequate and stable supply of materials necessary to maintain national security, economic well-being, and industrial production with appropriate attention to achieving a long-term balance between energy needs, a healthy environment, and natural resources conservation and social needs. (3:71)

The Act requires the President to submit to Congress a plan detailing long-range policy analysis of materials needs and industrial and economic implications of supply shortages or disruptions (3:71). It also requires the President to coordinate policy activities at the appropriate Cabinet level agency. It further tasks the Office of Science and Technology, and the Secretary of Commerce in coordination with the FEMA, the Secretary of Interior, the Secretary of Defense and the Director of the Central Intelligence Agency to work together on required reporting of materials status and needs (3:72).

The most recent legislation passed to support the philosophy of a national materials policy is the Arctic

Research and Policy Act of 1984 - National Critical Materials Act of 1984 (P. L. 98-373). The Act created the National Critical Materials Council which is tasked to:

> (A) establish responsibility for and provide for necessary coordination of critical material policies, including all facets of research and technology, among the various agencies and departments of the Federal Government, and make recommendations for the implementation of such policies;
>
> (B) bring to the attention of the President, the Congress and the general public such materials issues and concerns, including research and development, as are deemed critical to the economic and strategic health of the Nation; and
>
> (C) ensure adequate and continuing consultation with the private sector concerning critical materials, materials research and development, use of materials, Federal material policies, and related matters. (5:Sec. 202b)

Stockpile Status

Currently the NDS consists of 61 family groups of minerals and non-food agricultural materials. In these groups, there are 93 commodities, 80 are of mineral origin and the remainder are agricultural products. Stockpile goals have been set for 64 of the 80 mineral commodities representing 34 different minerals (2:7-8).

The current stockpile inventory is valued at $10.9 billion. Of that, $7.1 billion is held against current stockpile goals while $3.8 billion of inventory are materials considered surplus. If all current stockpile goals were met, the value of materials would exceed $17 billion. The cost of materials to fill existing goals is

Table I

NDS Inventory Groups (6:22-26)

No. Of Mineral Groups	Percent Of Goal Filled
11	0 to 19
6	20 to 39
11	40 to 59
3	60 to 79
6	80 to 99
24	100 plus

$10.2 billion (6:v). Appendix A summarizes the NDS inventory of strategic and critical materials (6:22-26). The inventory status of the 61 family groups is shown in Table I. Twenty-four groups and individual materials equal or exceed goals. Thirty-seven groups or individual minerals have inventory levels less than goals. It is important to note that of the 37, 17 materials are below 40 percent of the goal (2).

Import Dependence

Since 1870 the United States changed from being a net exporter of raw materials to being a net importer (3:16). Table II provides an historical perspective of this country's move to its current import dependent position. After analyzing projected domestic production and estimated annual consumption in the year 2000, the U. S. Bureau of

Table II

Net U. S. Imports Of Selected Metals As A Percentage Of Apparent Consumption, 1900 To 1980 (3:17)

Year	Copper	Iron Ore	Lead	Manganese	Nickel	Zinc
1900	E	3	E	96	100	E
1920	E	0.2	12.5	86	100	E
1929	0	2.5	3.9	92	100	E
1939	E	2.5	1	96	100	7
1950	31	11	40	77	90	41
1960	E	18	33	89	72	46
1965	15	32	31	94	71	54
1970	E	30	22	95	71	54
1975	E	30	11	98	72	61
1980	14	22	E	97	73	58

E = Net Export

Mines data projects the situation will continue in the foreseeable future (3:16,21).

For 1982,the United States was a net importer for 28 of the 29 strategic and critical materials included in the NDS. The minerals and net import reliance figures are shown in Appendix B. Of the 28, U. S. dependence on imports exceeds 90 percent for seven and is between 50 and 90 percent for nine others (7:40-41). United States reliance on imported supplies of some minerals has grown dramatically over the past two decades because U. S. deposits have been depleted,

environmental restrictions have been implemented and industrial output has increased to meet higher demands. For example, dependence on imported bauxite and alumina increased form 74 percent in 1960 to 97 percent in 1982 and on imported cobalt from 66 percent in 1960 to 91 percent in 1982. The U. S. was a net exporter of copper and vanadium during 1960; however, net import reliance grew to 7 and 14 percent respectively for 1982 (2:7).

World War II marked the beginning of not only this country's, but a worldwide change in minerals commodity requirements. To meet this demand, expansion of minerals production took place on a worldwide basis and as a result, a competitive international market developed. Domestic consumers saw this as an opportunity to benefit from increased competitive markets thereby increasing imports (3:21). While this situation in itself is not harmful, it did perpetuate U. S. import dependence.

The Paley Commission, referred to earlier, regarded the idea of a materials self-sufficiency, even for national security, as "fallacious and dangerous." It favored instead the least cost principle, that the national materials policy be founded on the principle of buying materials at the least cost possible (3:35).

The least cost principle was reinforced by The National Commission on Materials Policy, created by the National Materials Policy Act of 1970. The Commission found that the

United States continued to import most materials vice domestic production, due to availability at lower prices than those for domestic supplies. The Commission further noted that it might be unwise to become dependent on specific strategic commodities for which the U. S. lacks a resource base or that are obtained from countries which may choose to restrict or cut off supplies (3:36). The Commission recommended that the U. S. expand domestic production, diversify sources of supply, develop stronger trade relations with supplying countries and allocate existing supplies on a priority system (3:37).

The issue of import dependency continued to be the concern of Congressional commissions and conferences. The National Commission on Supplies and Shortages (1974) addressed the possibility of minerals cartels against the United States. The all-too-familiar oil shortages of the 1973 embargo generated some serious concern. The Commission determined; however, that minerals embargoes deliberately directed against the United States were only remotely conceivable (3:38).

Since 1970 the Biennial National Materials Policy Conferences have reviewed the wide range of economic and political factors concerning reliance on overseas supplies of materials. Although each conference focused on different areas, there was a general consensus of findings. The United States Government, while very much import dependent

for certain minerals, must develop long-term plans and policies to deal with the economic and military security of this nation (3:39-45).

More recent concerns are expressed in the findings of subcommittee reports to both the House and Senate:

> No issue facing America in the decades ahead poses the risks and dangers to the national economy and defense presented by this Nation's dependence on foreign sources for strategic and critical minerals. (8:vii)

and

> A shortage of critical materials, combined with a resulting dependence on uncertain foreign sources for these materials, is eroding the foundation of U. S. Defense capabilities. These shortages are a monumental challenge to the Congress, the Department of Defense, the industry and the civilian economy. (9:24)

In testimony before the Industrial Preparedness Panel of the House Armed Services Committee in November 1980, General Alton Slay stated that our alarming dependence on imports of critical raw materials from unstable sources creates a potentially dangerous flaw in our nation's defense preparedness posture (10:III-6). The General pointed out that in terms of many essential non-fuel minerals, the U. S. is a "have not" nation. The United States has grown dangerously dependent on foreign sources of minerals essential to defense uses as well as for our entire industrialized economy (10:III-7).

Much of the world's production of many strategic and critical materials comes from two areas of the world: the

Soviet Union and and southern Africa. These two areas contain 99 percent of the world's reserves of platinum group metals; 80 percent of the world's manganese ore; 97 percent of the world's vanadium; 96 percent of the world's chrome; 87 percent of the world's diamonds; 60 percent of the world's vermiculite; and 50 percent of the world's fluorspar, iron ore, asbestos, and uranium. Zaire and Zambia in southern Africa now provide 65 percent of the world's cobalt (10:III-3).

Defense programs increasingly generate high demands for such materials as chromium, cobalt, columbium, molybdenum, nickel, platinum, tantalum, and titanium. Sophisticated military equipment requires materials resistant to high temperatures, corrosion, and erosion. For example, the Pratt and Whitney F-100 Turbofan engine for the F-15 and F-16 aircraft requires 5366 pounds of titanium, 5204 pounds of nickel, 1656 pounds of chromium, 910 pounds of cobalt, 720 pounds of aluminum 171 pounds of columbium and 3 pounds of tantalum (11:H-3). Improved thermodynamics efficiency requires these high-temperature metals. The titanium steel and aluminum alloys used extensively in aircraft and missile production are alloyed with cobalt, tantalum, chromium and vanadium (12:10).

Vulnerability

When discussing U. S. dependence on imported materials, the appropriate follow-on would deal with our vulnerability

to being cut off from the sources of our strategic and critical materials. Specifically, vulnerability deals with a number of factors. These include the degree of monopoly in the mineral supply, the availability of minerals, the criticality of the mineral's uses, the circumstances that could result in a reduction or stoppage of supply and the availability of alternatives (2:2).

Many minerals crucial to the defense industry and the civilian economy are imported exclusively from either the Soviet Union or potentially unstable nations in southern Africa (7:1). As an example of our vulnerability to the degree of monopoly in and availability of the mineral supply, consider the May 1978 Angolan rebel invasion of Zaire. At that time, Zaire provided 65 to 70 percent of the world supply of cobalt. The effects of the invasion were felt throughout the world by significant price increases ($5 per pound in 1978 to $50 by mid-1979) and reduced supplies for even the most well established customers (13:47).

The Soviet Union plays an important role in the area of vulnerability. Soviet influence, in line with their minerals policy, has increased the likelihood that the minerals supply could be interrupted at any time. In 1973 Leonid Brezhnev voiced the Soviet policy:

> Our aim is to gain control of two great treasure houses on which the West depends: the energy treasure house of the Persian Gulf and the mineral treasure house of central and southern Africa. (15:33)

In 1980, the Soviet Union entered a long-term agreement with Zambia to exchange cobalt and other minerals for Soviet weapons and training of Zambian military personnel (16:4).

Retired Rear Admiral William Mott expressed concern about the vulnerability of the U. S. to the criticality of mineral uses during his testimony to a House Subcommittee on Armed Services:

> Like the mushroom cloud of an atomic explosion, shortages of strategic materials would spread from industry to industry and ultimately blanket every corner of our industrial base, threatening our standard of living, our very society itself. Shortfalls in just four strategic materials (chromium, cobalt, manganese, and platinum) could cause shutdowns or slowdowns in such basic industries as: transportation, construction, manufacturing, electronics, steel, oil, chemicals, technology and even agriculture. That would throw untold millions of Americans out of work, shoot prices through the roof, render the dollar practically valueless. Even the nation's ability to defend itself would be in grave doubt. The resultant social and political repercussions in the country would defy the imagination. (17:137-143)

Alternatives

Not all views on the mineral import dependence and vulnerability express the sense of urgency as presented thus far. Some financial and business experts feel that the mineral and metals business is such a small part of the Nation's gross national product that a reduction or even stoppage of materials imports would have little effect on our economy. For example, Dr. Charles Schultze, former Director of the Bureau of Budget, stated in testimony before the House:

> Any modern industrial economy and particularly in the United States, is incredibly quick to adapt to shortages of particular materials. Substitutes are quickly discovered, synthetics developed, and ways found to minimize the use of short-supply items. If all imports to the United States were cut off and every one of our overseas investments expropriated, the U. S. economy would not collapse. Our standard of living would suffer, but not by a large amount. (18:150)

This alternative then is to down-play the role of materials imports to the economy and to let basic economic theory of supply and demand dictate the degree of dependence and vulnerability on imported materials.

In a tutorial lecture before the Seventh Biennial Conference on National Materials Policy, Hans Landsberg pointed out that while the 1973 oil embargo required certain economic "adjustments" in the U. S., it did not "plunge the Nation into disaster" (19:17). However, Landsberg went on to point out that no matter how one views the dependence and vulnerability threat to the U. S., there is still a substantial risk. He points out a number of "remedies" or alternatives to reduce the risk. Landsberg suggests substitution of materials, recycling to reclaim materials, expanding domestic production through provisions of the Defense Production Act, and intensifying the metals and minerals research and development. He contends that while there are several alternatives available, strategic stockpiling is at the top of the list (19:20,23).

Under sponsorship of the Aeronautical Systems Division of the Air Force Systems Command, a team of industrial and

Air Force personnel were brought together to analyze the status of the U. S. aerospace industrial base (20). The panel expressed concern about the potential loss of foreign sources of strategic and critical materials. The loss of supply, especially for electronic component materials, "will severely hamper industry's ability to mobilize. Several alternatives are available to foreign source dependency" (20: Vol I, 23). The panel suggested an increase in the development of domestic sources, designing out foreign source materials and substitution. They also remarked that the associated costs and leadtimes involved could be prohibitive. Stockpiling of critical components and materials was cited as the most visible option to support the production base (20: Vol I, 23-24).

The United States has a wide range of options to reduce its dependence and vulnerability on imported non-fuel minerals. Leaders of industry, government and the military see the issue of stockpiling as one of the most efficient methods of reducing risk. One method of increasing stockpiled materials is by purchasing quantities of materials for which shortages exists in the NDS. As mentioned earlier, the cost to fill all shortages in the NDS would run over $10 billion. Estimates based on the past five years cumulative obligations and assuming costs would be offset by the sale of surplus materials, it would take well over 100 years to procure materials to meet 100 percent of 1984 NDS goals (6:8-9).

A second alternative concerns establishing economic stockpiles. This issue has been discussed frequently in Congress during the past ten years. In 1976 the Office of Technology Assessment concluded that a government controlled economic stockpile could be created to effectively reduce the impact of a nonpolitical import disruption. With this type of stockpile the Federal Government would intervene and influence the policies and prices of the minerals marketplace (21). The idea produced strong opposition at the time from those in the mining and metal producing community. They preferred that the Government not engage in purchases that would tend to raise costs at a time when markets for metal products were likely to be weak (2:67).

Privately-owned stockpiles have also been considered as an alternative. Privately held industrial stockpiles are seen as offering the advantage of a stockpile alternative that does not require Federal management and direct expenditure. However, while most private industry does hold a stockpile inventory, it is usually in quantities to support only short-term supply delays. The reasons are largely economic (3:246-247). Bohdan Szuprowicz states that since high technology industries are generally only sporadic users of strategic materials the industry sees little need to build stockpiles. He says:

> A stockpile is not an interest-bearing investment, and it absorbs insurance and storage costs. Management tends to stress minimizing inventories rather than building stockpiles for

> possible, but unlikely, emergencies, particularly in times of high interest. (13:49)

John D. Morgan, of the Bureau of Mines, expressed his views on private stockpiling. He stated:

> The use of flywheels to deliver power to offset sudden increases in load is accepted practice in machinery design, use of surge bins is standard practice in materials handling. Expanding such analogies to national economies points to the desirability of maintaining larger than normal working inventories to deal with unexpected interferences with normal supplies. However, escalating costs and higher interest rates in recent years have tended to discourage the private sector from maintaining large inventories. (22:43)

William Manly voiced support for privately owned stockpiles supported by government-industry cooperative effort. As Senior Vice President of Cabot Corporation, a metal alloy producer, he stated before the Subcommittee on Science, Technology and Space that:

> Private stockpiling of certain minerals should be explored even if only on a trial basis, using either provisions of Title III of the Defense Production Act or tax subsidies to encourage industry's cooperation in holding minimum stocks that could be dedicated to government use during an emergency. In general, private stockpiling has two advantages. It can be less expensive than government stockpiles because of reduced acquisition and carrying costs. Furthermore, because companies are intimately acquainted with the materials used in their own manufacturing processes, there is a higher probability that the quantity, quality and form of the stockpile will be optimum at any given time, that inventories will be rotated properly and that records and analyses will be effectively maintained. (23:22)

T. W. Stanley of the International Economic Policy Association suggested in 1983 that the government consider a

pilot project in private stockpiling. Eligible companies would receive financial incentives from the government to increase normal inventory holdings of certain critical materials. He believes the concept would reduce government cost by dividing both costs and benefits of such stockpiles between industry and government (23:138).

The idea of stockpiling is not a new one. Switzerland began private stockpiling just after World War II. France developed a stockpiling program in 1975 and Japan established its program in 1976. Tax incentives for maintaining larger than normal working inventories have been in effect in Sweden for a number of years. Appendix C provides a more detailed look at the private stockpiling policies of Sweden, Switzerland, France and Japan (14:1-5). It is important to note that Japan and these European nation governments tend to work much more closely with their industries to avoid possible strategic materials shortages by providing tax incentives and by sponsoring special investment programs (13:49).

Summary

The National Defense Stockpile has suffered the effects of mismanagement from its inception in 1939. However, passage of the National Critical Materials Act of 1984 provides for Presidential level responsibility to ensure a more coordinated and integrated management of strategic and critical materials. Shortages in meeting stockpile goals

for thirty-seven groups or individual minerals reflects the tremendous investment required to fill the stockpile. Over $10 billion is required to meet existing goals. The defense industry has traditionally relied upon the Federal Government and the NDS to provide the strategic and critical materials that would greatly impact our economy were supplies cut off. During the 1960's and the 1970's, industry expressed little or no concern over our growing dependence on imported materials and considered any type of slowdown in supply very unlikely. Even the oil cartels and embargoes of 1973 did not change the philosophy of many industrialists. They felt that world economic and market pressures of international trade would never allow any serious disruption to the mineral supply. More recently, however, industrialists and Congressional leaders have expressed concern about the growing import dependence and vulnerability. The idea of a cooperative industry and government relationship to establish private, strategic and critical material stockpiles has gained new interest. However, the maintenance of a larger than normal stockpile is expensive and requires capital that industry cannot afford to tie up, because if the money is borrowed, interest becomes a significant factor. Several foreign countries work closely with their private stockpilers providing the necessary financial incentives and tax credits needed to build private stockpiles.

Chapter III discusses the methodology used to measure the degree of acceptance by major DoD contractors of private stockpiling and the preference ranking of possible financial incentives for developing such stockpiles.

III. Methodology

Justification

The versatility of the survey method of research is one of its greatest strengths. Often it is the only practical way and most economical method of obtaining certain types of information. Emory asks, "How can we learn about what a person believes except by asking" (24:213)? Festinger and Katz say that the best examples of survey research use personal interviews as the principal method for data-gathering (25:412). The plan of this research effort used those ideas.

Chapter II of this paper provided a number of discussions concerning the development of private, economic stockpiles. From the discussions comes an often-repeated list of possible incentive alternatives that could potentially induce strategic and critical materials users to develop privately owned and operated materials stockpiles. However, research revealed no existing survey of the users nor any listing of preferences for the incentive programs mentioned. If such incentive programs were to be utilized, a survey designed to answer investigative question number two would be beneficial to Federal program planners. Therefore, the personal interview was chosen as the method to obtain contractor response and incentive preference rankings.

Interview Schedule

Emory defines the interview schedule as "a structured set of questions which are usually asked orally and recorded in writing by the interviewer" (24:214). The data considered essential to answer the investigative questions was collected using the interview schedule in Appendix D. The schedule consists of a set of questions that was asked orally with the interviewer recording the responses in writing. The structured set of questions was designed to reduce possibility of the measurer contributing as a source of error (24:127).

The interview schedule consists of four questions. The total number of questions was limited due to the time constraints on the interviewee and on the overall research effort. The schedule was structured so the respondent could readily comprehend what was being asked without frequent repetition. An explanation of each question and the corresponding level of measurement follows:

a. Introductory Question: "What is your job title?" (Nominal); designed to control the reliability of the response by establishing the level of expertise of the respondent. The response was deemed reliable if the job title reflected the appropriate corporate level and familiarity with the subject to answer the interview questions.

b. Question 1: "Does your company consider private economic stockpiling as an acceptable alternative to reduce vulnerability to possible reductions in or cessations of the imported material supply?" (Nominal); designed to provide a fixed alternative for the respondent. Responses were an important factor in answering investigative question number one. The responses also provided differentiation of respondents into subgroups for further analysis pertaining to investigative question number two.

c. Question 2: "The following incentive programs could influence your company's decision to develop an economic stockpile dedicated solely to support DoD requirements. Rank the incentives from the most influential (Rank of 1) to the least influential (Rank of 7)" (Ordinal); designed to establish a rank order of the most preferred incentive to the least preferred incentive for each respondent. Results were used to answer investigative question number two. The question was designed to provide the respondent with a list of proposed incentive alternatives. However, the question was left open-ended for individual response as an effort to reduce the bias of offering a limited selection of alternatives.

d. Question 3: "What would be the most significant advantage or disadvantage to establishing private economic stockpiles?"; designed to provide open response to the issue of private, economic stockpiling. Results were compiled and

enumerated as received from each respondent. Answers were reviewed for repetitive replies but were not correlated statistically. The responses helped answer investigative question number three.

Validity of Interview Schedule. Prior to actual data collection, the interview schedule was "tested" with five Materials Managers of various DoD contractors. The managers were representative of the level of position for which the survey was designed. Each respondent was asked to answer each interview question and then respond to the design of the question. This activity was useful in establishing a standardized interview technique and for revising interview questions based on replies and recommendations of the "test" group of respondents.

Population Sample

The target population for this research was fixed. The population of interest was limited to Department of Defense contractors engaged in producing items made from or utilizing quantities of strategic and critical materials.

The sample selection was a random selection of 30 of the top 100 DoD contractors as reported in the April 1984 Aviation Week and Space Technology magazine (26:166,173). The top 100 contractors are listed in numerical order from the highest dollar value of contracts to the lowest dollar value. The selection of the sample was facilitated with the choice of a random variable from a 1955 Rand Corporation

random number table (24:518). The Materials Manager from each of the 30 contractors was contacted for the interview.

As standardization of contracting procedure is common practice between the Federal Government and contractors, the selection of 30 of the top 100 DoD contractors was deemed by the researcher as representative of the target population.

Data Collection

The data collection process consisted of two phases. Phase One included preparation of the interview schedule for mailing to selected DoD contractors. Corporate addresses were retrieved from the *Aviation Week* magazine and from the Standard and Poor's *Register of Corporations* (27) located in the library of the Air Force Institute of Technology. Advanced copies of the interview were mailed to the target sample. A follow-up telephone call established an appointment with the respective Material Manager for conducting the interview. Phase Two consisted of the telephone interviews. All interview sessions were conducted as follows:

1. The interviewer introduced himself and the purpose and the focus of the research.

2. The interviewer emphasized that all information obtained during the interview would be treated with anonymity; the respondent's title would not be associated with the company name.

3. The interviewer emphasized that the responses should reflect corporate views as much as possible and not personal opinion.

4. The interviewer read the interview questions to the interviewee and recorded the response in writing.

Responses were categorized based on reply to question number one. The responses were then scored based on a percentage criterion developed by the researcher with a chi square analysis. The rank order results were analyzed using a nonparametric statistical test.

Assumptions and Limitations

The significant assumptions applied to this analysis were:

1. The data collected for analyzing acceptance and preference ranking of private stockpiling incentives were independently obtained from the sampled contractors.

2. By virtue of the position held by the respondent, he/she was knowledgeable of strategic and critical materials issues as well as the company's use of such materials.

3. Individual responses to the interview were representative of the corporate view and not personal opinion.

4. The standardized interview technique did not bias the data collection.

Factors limiting the research effort were:

1. Time constraints on the overall research effort and of the questionnaire approval process limited the number of contractors surveyed. Although the personal interview via the telephone was used, it also limited the length and depth of the questioning process.

2. Due to the absence of any previous study in the area, there was no published data for replication, comparison or use for research validation.

Statistical Tests

Emory states that nonparametric statistical tests are the only ones usable with nominal data and are the only technically correct tests for ordinal data (24:413). Siegel points out that the *nonparametric test does not specify* conditions about the parameters of the population from which the sample was drawn. He goes on to say that nonparametric tests do not require measurement as strong as do parametric test and that most nonparametric tests apply to data in the ordinal scale and some apply to data in the nominal scale (25:31).

The measurement level of the preference of economic stockpiling was nominal when summarized. The incentive alternatives previously mentioned were ordinal when ranked by the respondents. Therefore, the use of nonparametric tests was deemed most appropriate for the data analysis. Due to the level of measurement achieved and the limited

knowledge of the target population distribution, the advantages of the nonparametric test outweighed the disadvantages (25:32). Siegel points out the advantage of nonparametric testing is to "treat data which are inherently in ranks as well as data whose seemingly numerical scores have the strength of ranks." Additionally, he says nonparametric methods treat data "which are simply classificatory, i.e., measured in a nominal scale" (25:33).

Chi Square One-Sample Test

The chi square (χ^2) test is one of the most widely used nonparametric test of significance for cases when objects, persons or events are grouped into nominal categories (24:415). This test is of the goodness-of-fit type used to test whether a significant difference exists between the observed number of responses falling into a category and the expected number based on the null hypothesis (25:43).

For this analysis, the degree of acceptance by DoD contractors of economic stockpiling as an alternative for reducing vulnerability was subjectively set at a 60 percent acceptance criterion. No historical data existed for comparison; therefore, the decision rule was selected based on practicality and convenience of applying the chi square test. At the 60 percent level, the expected frequency of observations would exceed 5 in each category as required to determine probabilities associated with the test (25:46).

If there was agreement between the observed responses and the expected frequency of response (i.e., number yes and no), the differences would be small and consequently the chi square value would be small. If the differences were large, the resulting chi square value would also be large. The decision criterion would be based on the significance of variation in observations to expected frequencies.

The specific steps in computing the value of chi square were:

1. State the Null hypothesis. H_o: O = E. In this case the number of actual observations (O) was expected to equal the expected frequency (E) of 60 percent of the total observations falling into the "Yes" category with the remaining 40 percent falling into the "No" category.

2. Place the observed frequencies into the "Yes" or "No" category. The sum of the frequencies should be N, the number of independent observations.

3. Determine the number of expected frequencies for each of the categories.

4. Compute the value of chi square using the formula

$$\chi^2 = \sum_{i=0}^{k} \frac{(O_i - E_i)^2}{E_i} \qquad (1)$$

where

O_i = Observed number of cases in the i^{th} category

E_i = Expected number of cases in the i^{th} category

k = Number of categories

5. Determine value of degrees of freedom: df = k-1.

6. Determine the critical value of chi square from a probability table (25:249). If the computed value of chi square is greater than the critical value, based on a specified significance level, reject the null hypothesis and conclude there was a significant difference between the expected acceptance level for economic stockpiling and the actual level of acceptance by the DoD contractors.

Level of Significance. The level of significance the researcher chooses to use depends on the "importance or practical significance of his findings." Siegel further states that the researcher should indicate the actual probability level associated with the findings to allow the reader to use his own judgment in deciding whether to accept or reject the null hypothesis (25:9).

Due to the importance of determining whether the stated alternative was acceptable, a significance level of .05 was chosen for testing the null hypothesis by the chi square method. The results of the chi square test are shown in the computation table of Appendix E to allow individual determination of acceptance or rejection of the null hypothesis.

Kendall Coefficient of Concordance: W

The Kendall coefficient of concordance W is used to determine the association among several sets of rankings of objects or individuals. One approach to visualizing this measure is to picture how the data would look if there were no agreement among the several sets of rankings and then imagine how it would look if there were perfect agreement. The coefficient of concordance W is an index of the divergence of the actual agreement shown in the data from the perfect agreement (25:230). The value of W was used to reflect the degree of variance among the incentive programs sums of ranks and the degree of agreement among those contractors that accepted economic stockpiling as an alternative (Yes) and those that did not see economic stockpiling as an alternative to reducing import vulnerability (No) (25:230-231).

Computing the Value of W. To compute the value of W, the data was placed in a K by N table, where K is the number of contractors surveyed and N is the number of incentive alternatives. The remaining steps were:

1. For each incentive alternative, sum the ranks of the alternative from each contractor to find R_j.

2. Compute the mean of the R_j values. Express each R_j as a deviation from the mean value. Sum the squares of the deviations to obtain the value for S.

3. Calculate the value of W using the formula

$$W = \frac{S}{1/12\ K^2\ (N^3 - N)} \qquad (2)$$

4. If the proportion of the tied ranks in the K sets is large, calculate the value for T_k for each of the contractors. The correction factor is

$$T = \frac{\sum (t^3 - t)}{12} \qquad (3)$$

where

t = number of observations in a group tied for a given rank

Then calculate the value of W using the formula

$$W = \frac{S}{1/12\ K^2\ (N^3 - N) - K \sum_{1}^{K} T_k} \qquad (4)$$

where

$\sum_{1}^{K} T_k$ = the sums of all T_k values for all K sets of rankings

<u>Testing the Significance of W</u>. The significance of the computed value of W is tested by determining the probability associated with the occurrence under the null hypothesis of a value as large as the S with which it is associated. For small samples (N is 7 or less) critical values of S associated with W's are tabled for .05 and .01 significance

levels (25:286). For N larger than 7, the chi square distribution is used to determine the probability associated with the occurrence under the null hypothesis of any value as large as the observed W (25:236). The value is given in the formula

$$\chi^2 = K(N-1)W \tag{5}$$

with the degrees of freedom for the tabled critical value equal to N-1.

The null hypothesis tested was that the K set of rankings were unrelated, meaning there was no agreement among the contractors regarding the ranking of the incentive programs. At the specified significance level and N-1 degrees of freedom, if the computed value of χ^2 equaled or exceeded the tabled critical χ^2 value, the null hypothesis would be rejected. This means that the agreement among the contractors rankings was higher than it would have been by chance (25:235-237).

Level of Significance. Due to the importance of determining agreement among contractors, a significance level of .05 was determined acceptable for testing the null hypothesis under the Kendall coefficient of concordance W.

Interpretation of W and R_j. Kendall suggests that the best estimate of the preferred ranking of objects is provided, when W is significant, by the order of the sums of ranks, R_j (25:238). The best estimate of the most preferred

incentive would be that with the lowest R_j value, the next most preferred with the next lowest R_j and so on. Therefore, arranging the incentive alternatives in descending order allowed the researcher to determine the relative order and importance of the incentive programs. This activity provided the answer to investigative question number two.

Summary

This chapter described how the data collection was facilitated through the personal interview. The use of nonparametric statistical tests were required for both the nominal and ordinal data. The acceptance/nonacceptance of the private stockpiling alternative was measured by the chi square one-sample test. The Kendall coefficient of concordance W test measured the degree of agreement among the contractors on the rank order of possible financial incentives.

Chapter IV presents the analysis of the contractor's responses as they relate to the research objectives.

IV. Data Analysis and Findings

Introduction

The two objectives of this research, as stated in Chapter I, were established to consider the acceptance of private, economic stockpiling by Department of Defense contractors and what, if any, suggested incentive program or programs might influence the contractors to establish such stockpiles. This chapter presents the researcher's analysis of the answers to the four interview questions as they relate to the research objectives.

Interviewee Response

The response rate of the thirty contractors contacted for the interviews exceeded 70 percent. Of the thirty, only four failed to respond in any way. Those that provided no response cited corporate policy of non-participation in market surveys as the reason for not participating in the interview. Of the remaining twenty-six contractors, four agreed to participate in the interview but failed to provide a rank-order of the incentive programs listed in question two of the interview schedule. The four responses were used to answer investigative questions one and three but were not included in the analysis for investigative question number two.

The interview schedule was directed to corporate personnel most familiar with the materials policies and operations of the selected contractors. The introductory question of the interview requested the specific job title of the respondent. The intent of the question was to establish a guide, based solely on the researcher's discretion, for the level of expertise of the respondent on the subject of the interview. The researcher found that all respondents were very knowledgeable of the subject and each displayed an interest in the topic.

The researcher found that the job titles could be classified into three categories. Sixteen of the thirty contractors contacted directed the questionnaire to personnel in the first of the three categories; Directors/Managers of Materiel. For nine of the contractors contacted, the material management activity was in the functional area of purchasing and/or procurement. The remaining five contractors placed the material management activity into a general "other" category which included Marketing, Operations and Materials Engineering.

While each interview was conducted with the individual responsible for material management policy of the particular contractor's company, the researcher often spent a great deal of time trying to find the specific individual. The material management activity was often buried within the corporate structure. Fewer than 15 percent of the sampled

contractors listed Material Management at the level of corporate Vice-President.

Investigative Question One

Is the economic stockpile an acceptable alternative to Department of Defense contractors as a means to reduce vulnerability to mineral shortages?

Findings. Interview question number one was designed to measure the acceptance of economic stockpiling by DoD contractors. Based on the decision criteria presented in Chapter III, if 60 percent or more of the respondents answered "Yes" to the question, economic stockpiling would be deemed by the sampled contractors as an acceptable alternative for reducing vulnerability to mineral shortages. The measurement of responses showed the computed value of chi square to be greater than the critical value, based on a .05 significance level. There was sufficient evidence to reject the null hypothesis, meaning the sampled contractors did not consider the alternative as acceptable (Appendix E). Less than 35 percent of the respondents found the alternative acceptable while over 65 percent did not consider economic stockpiling as an acceptable alternative.

Although not specifically asked, several of the contractors that answered "No" volunteered that cost was the prohibitive factor involved. The holding of large amounts of inventory was contrary to the corporate philosophy of maximizing stockholders return-on-investment.

Investigative Question Two

What type of incentives are required by U. S. Defense contractors to carry excessive stocks of strategic and critical materials dedicated solely to defense programs?

Findings. Interview question number two provided each respondent the opportunity to rank order (from 1 for the most preferred to 7 for the least preferred) possible incentive programs that might influence the contractor's decision to develop a private, economic stockpile of strategic and critical materials. Use of the Kendall coefficient of concordance allowed the researcher to measure the degree of association among the rankings of all contractors that responded. It was also used to compare the association of agreement on incentive rankings between those contractors that viewed economic stockpiling as an acceptable alternative (Subgroup 1) and those contractors that did not (Subgroup 2).

Rankings of All Contractors. Twenty-two of the thirty contractors interviewed provided rankings of the incentive programs. The responses were measured to test the null hypothesis that the contractors rankings were unrelated to each other.

When tested at the .05 significance level, the high value of W indicated that the null hypothesis could be rejected, meaning that there was significant agreement on incentive rankings among the contractors (see Appendix F, Table V).

Table III

Significance of W Test

	All Contractors	Subgroup 1	Subgroup 2
Degrees of Freedom	6	6	6
Computed W Value	.5080515	.4894515	.5768817
Computed Chi Square Value	67.062795	26.430381	44.996771
Critical Value at .05 Level of Significance	3.84	3.84	3.84
Results	Reject H_o	Reject H_o	Reject H_o
Agreement Among Contractors	YES	YES	YES

The chi square distribution was used to test the probability of occurrence, under the null hypothesis, of a value as large as the computed W value. Table III shows the computed and critical chi square values and the test results in determining the significance of W.

The interpretation of the significant value of W and the associated R_j values were used to provide the preferred ranking of incentives by the contractors. Arrangement of the incentive programs, from the lowest to highest R_j value, provided the relative order and importance of each incentive. The most preferred to least preferred incentives

for all contractors interviewed were:

Preference

1. Guaranteed DoD multi-year procurement contracts

2. Interest and carrying cost rebates paid directly by the Federal Government

3. Tax credit for materials held in excess of normal stock

4. Percentage of purchase cost rebates paid by the Federal Government

5. Tax free interest on bonds floated to finance inventories in excess of normal working stock

6. Low interest loans

7. Loan guarantees

Rankings of Contractor Subgroup 1. Nine of the contractors interviewed answered "Yes" to interview question number one indicating their acceptance of economic stockpiling.

The computed and critical chi square values in determining the significance of W are shown in Table III. There was sufficient evidence to reject the null hypothesis, meaning the agreement among the contractors on the incentive rankings was higher than it would have been by chance within the subgroup.

The significant value of W and the associated R_j values provided a method of ordering the incentives as determined by the contractors (see Appendix F, Table VI). The most preferred to the least preferred incentive programs for

those contractors in subgroup 1 were:

Preference

1. Interest and carrying cost rebates paid directly by the Federal Government

2. Guaranteed DoD multi-year procurement contracts

3. Tax credit for materials held in excess of normal stock

4. Percentage of purchase cost rebates paid by the Federal Government

5. Low interest loans

6. Tax free interest on bonds floated to finance inventories in excess of normal working stock

7. Loan guarantees

<u>Rankings of Contractor Subgroup 2</u>. Thirteen of the contractors interviewed answered "No" to interview question number one meaning they felt the economic stockpile was not an acceptable alternative for reducing import vulnerability.

Table III shows the significance of the W value for contractor subgroup 2 and the subsequent rejection of the null hypothesis. Again, this indicates there is agreement among the contractors of subgroup 2 on the rankings of the incentive programs. The associated R_j values of the rankings are shown in Appendix F, Table VII. Using these values as an indication of order and importance, the arrangement of the most preferred to the least preferred

incentive by the subgroup 2 contractors was:

Preference

1. Guaranteed DoD multi-year procurement contracts

(Tie) Interest and carrying cost rebates paid directly by the Federal Government

(Tie) Tax credit for materials held in excess of normal stock

4. Percentage of purchase cost rebates paid by the Federal Government

5. Tax free interest on bonds floated to finance inventories in excess of normal working stock

6. Low interest loans

7. Loan guarantees

Investigative Question Three

Are there any perceived advantages or disadvantages to creating private, economic stockpiles?

Findings. Interview question number three asked each respondent to list, regardless of previous answers, any advantages or disadvantages in establishing privately owned and operated economic stockpiles of strategic and critical materials. The following is a synopsis of the list of advantages cited.

a. Availability of materials was cited most often. Users would be assured through their own efforts that materials would be available when needed, especially during a national emergency

b. Private management of the stockpile could be achieved at a lower cost. Professional inventory management would assure rotation of stock, proper shelf-life control, and the most appropriate storage methods for each commodity

c. Economies of scale in bulk purchases would help reduce costs of inventories

d. Private industry is more knowledgeable of specific needs; this would result in more accurate forecasts of requirements

e. Industry would be able to cycle stock based on industry productivity

f. Private stockpiling would assure shorter lead times from need to actual use

g. Industry could buy back-and-forth from each other to overcome unfavorable external market conditions

h. The burden is off the government to foot the entire bill and risk of maintaining strategic and critical materials

The list of disadvantages reflects the negative response to the development of private stockpiles and slightly outnumbers the list of advantages. Some of the disadvantages present directly opposite views of the listed advantages. The disadvantages included:

a. Cost of inventory as the most frequent response. Inventory acquisition, storage and control costs limited the acceptance of private stockpiling

b. Complications of management would arise. Problems of priority allocation would be difficult to overcome. Identification of which materials for which contract would be difficult and there would be problems in providing sub-contractors with materials on an equitable basis

c. If left to private control, the government could loose assurance that the stockpile would be there when needed

d. An increased risk to the government that private industry would do the job desired

e. Aside from the priority issue, it would be difficult to determine who needs and gets materials an a daily basis. As requirements change, so would the most appropriate holder

of material. Some centralized stockpiling would still be required

f. Changes in requirements could also mean obsolescence of materials and lost investment to the holder

g. Contractors with stockpiled materials could receive favorable treatment on contract awards over contractors without stockpiles

h. Current DoD contracting procedures make the investment too risky without some kind of guarantee of buying back any unused or obsolescent assets

i. No guarantee of actual need for the materials (is the investment really worth it?)

j. The accuracy of private industry forecasts is questionable. Smaller contractors would have different standards and criteria than would the larger contractors

k. Long range forecasting would be better accomplished at a national level than at the industry level

l. The amount of physical storage space required and the added administrative nightmares involved is prohibitive to many contractors

Summary

Analysis of the interview responses shows that the sample of 30 of the top 100 DoD contractors do not find private, economic stockpiling of strategic and critical materials as an acceptable alternative for reducing import vulnerability. Although a number of incentive payback programs were suggested that might influence the contractors to establish such stockpiles, the problems of initial acquisition and maintenance costs were cited as the greatest prohibitive factors. The idea of cost (in various forms) to the company was also the disadvantage most often cited for not establishing private stockpiles.

There was some agreement upon the order and importance of the proposed incentive programs by all contractors whether each favored the private stockpile proposal or not. "Guaranteed DoD multi-year procurement contracts" was most preferred by all contractors and the subgroup of those that did not accept the alternative of private stockpiling. It ranked second with those contractors that provided a positive answer to the private stockpile alternative.

The next two most preferred incentive proposals for all three contractor groups include "interest and carrying cost rebates paid directly by the Federal Government" and "tax credit for materials held in excess of normal stock." There was also little variation among all the contractor and subgroup's rankings of the remaining four incentives. "Low interest loans" and "loan guarantees" ranked as the two least preferred of possible incentive programs to the contractors.

A summary of the research objectives and methodology is presented in Chapter V. Additionally, conclusions and recommendations are discussed with recommendations for further study.

V. Summary, Conclusions and Recommendations

Summary

The United States is a "have-not" nation for internal sources of strategic and critical materials. As a result, the United States has grown dangerously dependent on uncertain foreign sources of minerals and materials essential to defense uses as well as for our entire industrialized economy (10:III-7). This dependence is not bad in itself; however, it substantially increases our vulnerability to export slowdowns or shortages in the mineral and material supply.

Precautions to reduce this vulnerability were initiated by Congress in 1939 with the passage of the Strategic Materials Act. This Act and others that followed established the United States' mineral policy of stockpiling reserves of strategic and critical materials to counter the threat of loss of supply during periods of national emergency. The National Defense Stockpile (NDS) currently consists of 80 mineral commodities representing 34 different minerals (2:7-8). However, not all stockpile goals are filled, primarily due to the enormous costs involved.

Attention has turned recently to alternative methods for reducing the import vulnerability. Included are suggestions to increase the NDS quantities, subsidize domestic production, intensify metals and minerals research

for substitutes or build privately owned and operated stockpiles. A number of feasibility studies exist or are ongoing for most of these alternatives. However, the concept of privately owned and operated economic stockpiles has received little attention.

Several foreign governments have operated cooperatively with their industries to create successful stockpiling programs. From this concept came the two objectives of this research. The first objective was to determine if major Department of Defense (DoD) contractors consider private stockpiling as an acceptable alternative for reducing mineral import vulnerability. The second objective was to determine what types of incentives would induce defense contractors to consider establishing private stockpiles of strategic and critical materials.

The research focused on the data collected through personal interviews with Material Managers from 30 of the top 100 DoD contractors. Every manager was questioned on the acceptance of the private stockpiling alternative and was asked to rank order their preferences of possible incentive programs. The chi square one-sample test was used to measure the degree of acceptance of the private stockpiling alternative. The Kendall coefficient of concordance W was used to measure the degree of agreement among the contractors on the order of preference of the incentive programs. The analysis also compared the degree

of agreement on the rank order of incentive preferences for those contractors that found the private stockpiling alternative acceptable (subgroup 1) with those contractors that did not (subgroup 2).

The data analysis showed that major DoD contractors did not find private, economic stockpiling as an acceptable alternative. All contractors and the subgroup of those that did not accept the alternative agreed that "guaranteed multi-year procurement contracts" was the most preferred of the proposed incentives. The incentive ranked as the second most preferred by the subgroup of contractors that considered private stockpiling as an acceptable alternative. The next two most preferred incentive proposals for all three contractor groups included "interest and carrying cost rebates paid directly by the Federal Government" and "tax credit for materials held in excess of normal stock." Little variation in agreement was discovered on the remaining incentives with "low interest loans" and "loan guarantees" ranked as the two least preferred incentives by all the contractors interviewed.

Conclusions

The primary conclusion to be drawn from this research effort, based on the population sample, is that major DoD contractors do not consider private, economic stockpiling as an acceptable alternative for reducing import vulnerability. The problems of costs, in the various forms of inventory

acquisition, administration, tax liabilities, opportunity costs of other investments, and obsolescence of materials were the reasons contributing to the lack of acceptance. Many contractors expressed a valid concern over the lack of profit for stockholders that could be generated from excessively large quantities of a little used inventory. The disadvantage of cost was common to those contractors not accepting the economic stockpile alternative as well as those that did.

Direct financial support has long been used by our government to reduce the financial burden and risk of certain ventures by private industry. The suggested incentive programs to support private stockpiling were merely an extension of that philosophy. It is interesting to note that the "guaranteed DoD multi-year procurement contract" was more influential to the contractors than were the direct financial aid incentives offered. The possibility of long-term planning and the reduction of risk associated with the current DoD procurement system appears to have the most significant influence on the DoD contractors. While "interest and carrying costs rebates paid" and "tax credit for excess inventories" were highly ranked by all the contractors, the benefit of stabilized procurement and production planning was emphasized by the contractors. The researcher concluded that the contractors would be more receptive to establishing stockpiles were the

guaranteed multi-year procurement contracts used in conjunction with one or more of the highly ranked incentive programs.

Recommendations

Based on the findings of this research, Congress should not rely on private stockpiling of strategic and critical materials as a means of reducing vulnerability to imported materials. The current tax laws, market environment and financial subsidies offered by the Federal Government do not provide the financial security required by DoD contractors for establishing economic stockpiles. Therefore, the Department of Defense should continue to promote the use of multi-year contracting. The use of multi-year contracting has already helped realize considerable short-term dollar savings on recent major weapon systems contracts. The DoD must emphasize to Congress the potential benefits in coupling long-range procurement with specific short-range investment incentives as a method of assuring availability of the increasingly important strategic and critical materials. The DoD must continue to advocate improved management of the National Defense Stockpile. A cooperative effort between industry and the Government on long-term procurement guarantees and short-term financial incentives could provide the incentive to industry for investing in the economic stockpile. The results would not necessarily lesson our dependence on imported materials but it would tip

the balance of reducing imported material vulnerability in our favor.

Recommendations for Further Study

Recommendations for further study include:

a. As the research effort was limited by the small size of the sample, a larger sample of DoD contractors should be surveyed. This would extend the validity of the results of this initial effort.

b. A similar survey should be directed to companies functioning primarily as metals and minerals brokers. Such companies are more directly influenced by the economic pressures of the materials market and generally deal in larger inventory quantities than do DoD contractors.

c. Research should be conducted on a limited number of specific commodities in the NDS. The research should be a cooperative effort between a small number of strategic and critical materials users to determine, in hard dollars and cents, if any economic benefit could be realized through the *economic stockpiling option*. Each economic analysis could be tailored to a specific users requirements.

Appendix A: National Defense Stockpile Inventory (6:22-26)

The following National Defense Stockpile Inventory is taken from the Stockpile Report to Congress October 1983 - March 1984 , as prepared by the Federal Emergency Management Agency. Abbreviations used in the inventory include:

ST	Short Ton	(2000 pounds)
LDT	Long Dry Ton	(Excludes excess free moisture)
LCT	Long Calcined Ton	(Excludes water of hydration)
LB	Pound	
SDT	Short Dry Ton	
PC	Piece	
KT	Carat	(200 milligrams of diamond)
FL	Flask	(76 pound)
AMA LB	Anhydrous Morphine Alkaloid	(In pounds)
Tr Oz	Troy Ounces	(12 Tr Oz per pound)
Av Oz	Avoirdupois Ounce	(16 Av Oz per pound)
MT	Metric Ton	(2204.6 pounds)
LT	Long Ton	(2240 pounds)

Table IV

NATIONAL DEFENSE STOCKPILE INVENTORY OF STRATEGIC AND CRITICAL MATERIALS

Material	Unit	Goal	Inventory	Value of Inventory (Millions $)	Quantity After Crediting Offset: Excess	Quantity After Crediting Offset: Deficit
1. Aluminum Metal Group	ST Al Metal	7,150,000	4,043,784	$ 782.7		3,102,858
Alumina	ST	0	0	-		-
Aluminum	ST	700,000	2,080	3.4		697,920
Bauxite, Metal Grade, Jamaica Type	LDT	21,000,000	11,454,413 a	515.4		9,545,587
Bauxite, Metal Grade, Surinam Type	LDT	6,100,000	5,299,597	263.9		800,403
2. Aluminum Oxide, Abrasive Grain Group	ST Ab Grain	638,000	259,124	128.6		378,876
Aluminum Oxide, Abrasive Grain	ST	0	50,904	63.6	b	
Aluminum Oxide, Fused, Crude	ST	0	249,867	65.0	b	
Bauxite, Abrasive Grade	LCT	1,000,000	0	-		b
3. Antimony	ST	36,000	38,841	106.0	2,841	
4. Asbestos, Amosite	ST	17,000	38,495	27.0	21,495	
5. Asbestos, Chrysotile	ST	3,000	10,751	19.6	7,751	
6. Bauxite, Refractory	LCT	1,400,000	199,926	40.4		1,200,074
7. Beryllium Metal Group	ST Be Metal	1,220	1,061	204.2		159
Beryl Ore (11% BeO)	ST	18,000	17,987	21.8		13
Beryllium Copper Master Alloy	ST	7,900	7,387	93.5		513
Beryllium Metal	ST	400	229	88.9		171
8. Bismuth	LB	2,200,000	2,081,298	5.0		118,702
9. Cadmium	LB	11,700,000	6,328,809	10.4		5,371,191
10. Chromium, Chemical and Metallurgical Group	ST Cr Metal	1,353,000	1,315,823	1,006.8		28,077
Chromite, Chemical Grade Ore	SDT	675,000	242,414	13.6		c
Chromite, Metallurgical Grade Ore	SDT	3,200,000	2,456,225	237.0		c
Chromium, Ferro, High Carbon	ST	185,000	402,696	266.7	c	
Chromium, Ferro, Low Carbon	ST	75,000	318,892	418.0	c	
Chromium, Ferro, Silicon	ST	90,000	58,357	43.3		c
Chromium, Metal	ST	20,000	3,763	28.2		c
11. Chromite, Refractory Grade Ore	SDT	850,000	391,414	42.6		458,586

(Continues)

Table IV (Continued)

	Material	Unit	Goal	Inventory	Value of Inventory (Millions $)	Quantity After Crediting Offset Excess	Quantity After Crediting Offset Deficit
12.	Cobalt	LB Co	85,400,000	46,193,915	$ 577.4		39,206,085
13.	Columbium Group	LB Cb Metal	4,850,000	2,532,419	23.0		2,317,581
	Columbium Carbide Powder	LB Cb	100,000	21,372	.6		78,628
	Columbium Concentrates	LB Cb	5,600,000	1,806,218	15.5		d
	Columbium, Ferro	LB Cb	0	930,911	5.3	d	
	Columbium, Metal	LB Cb	0	44,851	1.6	d	
14.	Copper	ST	1,000,000	29,048	44.0		970,952
15.	Cordage Fibers, Abaca	LB	155,000,000	0	-		155,000,000
16.	Cordage Fibers, Sisal	LB	60,000,000	0	-		60,000,000
17.	Diamond, Industrial Group	KT	29,700,000	37,048,492	411.4	7,348,492	
	Diamond Dies, Small	PC	60,000	25,473	1.1		34,527
	Diamond, Industrial, Crushing Bort	KT	22,000,000	22,001,353	38.5	1,353	
	Diamond, Industrial, Stones	KT	7,700,000	15,034,403	371.8	7,334,403	
18.	Fluorspar, Acid Grade	SDT	1,400,000	895,983	161.3		504,017
19.	Fluorspar, Metallurgical Grade	SDT	1,700,000	411,738	51.5		1,288,262
20.	Graphite, Natural, Ceylon, Amorphous Lump	ST	6,300	5,498	10.7		802
21.	Graphite, Natural, Malagasy, Crystalline	ST	20,000	17,880	53.6		2,120
22.	Graphite, Natural, Other Than Ceylon & Malagasy	ST	2,800	2,804	2.0	4	
23.	Iodine	LB	5,800,000	7,450,930	51.3	1,650,930	
24.	Jewel Bearings	PC	120,000,000	71,951,970	61.7		48,048,030
25.	Lead	ST	1,100,000	601,025	318.5		498,975
26.	Manganese, Dioxide, Battery Grade Group	SDT	87,000	215,505	20.4	128,505	
	Manganese, Battery Grade, Natural Ore	SDT	62,000	212,494	16.2	e	
	Manganese, Battery Grade, Synthetic Dioxide	SDT	25,000	3,011	4.2		e

(Continues)

Table IV (Continued)

Material	Unit	Goal	Inventory	Value of Inventory (Millions $)	Quantity After Crediting Offset: Excess	Deficit
27. Manganese, Chemical & Metallurgical Group	ST Mn Metal	1,500,000	1,954,922	$ 489.5	470,395	
Manganese Ore, Chemical Grade	SDT	170,000	191,653	15.7	21,653	
Manganese Ore, Metallurgical Grade	SDT	2,700,000	3,360,168	159.9		f
Manganese, Ferro, High Carbon	ST	439,000	599,978	262.5	f	
Manganese, Ferro, Low Carbon	ST	0	0	-	-	
Manganese, Ferro, Medium Carbon	ST	0	28,920	20.8	f	
Manganese, Ferro, Silicon	ST	0	23,574	9.9	f	
Manganese Metal, Electrolytic	ST	0	14,172	20.7	f	
28. Mercury	FL	10,500	176,515	53.8	166,015	
29. Mica Muscovite Block, Stained & Better	LB	6,200,000	5,212,445	27.8		987,555
30. Mica Muscovite Film, 1st & 2nd Qualities	LB	90,000	1,179,537	13.8	1,089,537	
31. Mica Muscovite Splittings	LB	12,630,000	17,388,788	26.1	4,758,788	
32. Mica Phlogopite Block	LB	210,000	130,745	.7		79,255
33. Mica Phlogopite Splittings	LB	930,000	1,641,699	3.3	711,699	
34. Molybdenum Group	LB Mo	0	0	-	-	
Molybdenum Disulphide	LB Mo	0	0	-	-	
Molybdenum, Ferro	LB Mo	0	0	-	-	
35. Morphine Sulphate and Related Analgesics	AMA LB	130,000	71,303	26.2		58,697
Crude	AMA LB	0	31,795	4.9	g	
Refined	AMA LB	130,000	39,508	21.3		g
36. Natural Insulation Fibers	LB	1,500,000	0	-		1,500,000
37. Nickel	ST Ni+Co	200,000	32,209	143.7		167,791
38. Platinum Group Metals, Iridium	Tr Oz	98,000	26,590	9.5		71,410
39. Platinum Group Metals, Palladium	Tr Oz	3,000,000	1,255,008	201.4		1,744,992
40. Platinum Group Metals, Platinum	Tr Oz	1,310,000	452,642	179.9		857,358
41. Pyrethrum	LB	500,000	0	-		500,000
42. Quartz Crystals	LB	600,000	2,060,936	12.4	1,460,936	
43. Quinidine	Av Oz	10,100,000	1,874,504	6.7		8,225,496

(Continues)

Table IV (Continued)

Material	Unit	Goal	Inventory	Value of Inventory (Millions $)	Quantity After Crediting Offset: Excess	Quantity After Crediting Offset: Deficit
44. Quinine	Av Oz	4,500,000	3,246,164	$ 8.2		1,253,836
45. Ricinoleic/Sebacic Acid Products	LB	22,000,000	12,524,242	9.2		h
46. Rubber	MT	864,000	120,882	154.4		743,118
47. Rutile	SDT	106,000	39,186	12.7		66,814
48. Sapphire and Ruby	KT	0	16,305,502	.2	16,305,502	
49. Silicon Carbide, Crude	ST	29,000	80,550	36.2	51,550	
50. Silver, Fine	Tr Oz	0	137,505,946	1,326.8	137,505,946	
51. Talc, Steatite Block & Lump	ST	28	1,081	.4	1,053	
52. Tantalum Group	LB Ta Metal	7,160,000	2,426,387	142.0		4,733,613
Tantalum, Carbide Powder	LB Ta	0	28,688	4.7	i	
Tantalum Metal	LB Ta	0	201,133	44.2	i	
Tantalum Minerals	LB Ta	8,400,000	2,584,195	93.1		i
53. Thorium Nitrate	LB	600,000	7,131,812	19.6	6,531,812	
54. Tin	MT	42,700	190,354	2,450.8	147,654	
55. Titanium Sponge	ST	195,000	32,331	353.4		162,669
56. Tungsten Group	LB W Metal	50,666,000	77,472,074	496.1	26,806,074	
Tungsten Carbide Powder	LB W	2,000,000	2,032,942	23.3	j	
Tungsten, Ferro	LB W	0	2,025,361	24.8	j	
Tungsten, Metal Powder	LB W	1,600,000	1,898,831	24.5	j	
Tungsten Ores & Concentrates	LB W	55,450,000	84,036,358	423.5	j	
57. Vanadium Group	ST V Metal	8,700	541	6.5		8,159
Vanadium, Ferro	ST V	1,000	0	-		1,000
Vanadium Pentoxide	ST V	7,700	541	6.5		7,159
58. Vegetable Tannin Extract, Chestnut	LT	5,000	14,082	9.5	9,082	
59. Vegetable Tannin Extract, Quebracho	LT	28,000	131,250	89.8	103,250	
60. Vegetable Tannin Extract, Wattle	LT	15,000	15,001	10.6	1	
61. Zinc	ST	1,425,000	378,316	403.9		1,046,684

(Continues)

Table IV (Continued)

a. <u>Bauxite, Metal Grade, Jamaica Type:</u> Includes 400,000 LDT in the physical custody of GSA, title to which will be transferred to the Stockpile during Fiscal Years 1988-1990.

b. <u>Aluminum Oxide, Fused Crude:</u> Hold 50,904 ST of aluminum oxide abrasive grain and 249,867 ST of aluminum oxide fused crude as offset against 379,253 LCT of bauxite abrasive grade.

c. <u>Chromium Group, Chemical and Metallurgical Grades:</u> Metallurgical grade ore goal is 3,200,000 SDT of specification grade; inventory 1,956,824 SDT; shortfall 1,243,176 SDT.

(1) Hold 217,695 ST of Fe Cr high carbon against shortfall of 544,238 SDT of specification grade ore.
(2) Hold 243,892 ST of Fe Cr low carbon against 609,730 SDT of specification grade ore.
(3) Hold 89,208 SDT of nonspecification grade metallurgical ore against the balance of the 89,208 SDT specification grade ore shortfall.
(4) Hold 47,466 SDT of nonspecification grade metallurgical ore against a shortfall of 31,644 ST of Fe Cr Si.
(5) Hold 56,830 SDT of nonspecification grade metallurgical ore against a shortfall of 16,237 ST of chromium metal.
(6) Hold 337,715 SDT of nonspecification grade metallurgical ore against 337,715 SDT of chemical grade ore shortfall.

d. <u>Columbium Group:</u>

(1) Hold 930,911 pounds Cb as Fe Cb against 1,095,189 pounds Cb as concentrates.
(2) Hold 44,851 lb Cb as Cb metal against 52,766 lb Cb as concentrates.

e. <u>Manganese, Dioxide, Battery Grade Group:</u>

Hold 21,989 SDT of manganese, battery grade, natural ore against a shortfall of 21,989 SDT of manganese, battery grade, synthetic dioxide.

f. <u>Manganese Group, Chemical and Metallurgical Grades:</u> Metallurgical grade ore goal is 2,700,000 SDT; inventory 2,409,160 SDT; shortfall 290,840 SDT of stockpile grade ore.

(1) Hold 14,172 ST of Mn metal against 35,430 SDT of metallurgical ore.
(2) Hold 23,574 ST of Fe Mn Si against 42,433 SDT of metallurgical ore.
(3) Hold 28,920 ST of Fe Mn medium carbon against 57,840 SDT of metallurgical ore.
(4) Hold 77,569 ST of Fe Mn high carbon against 155,138 SDT of metallurgical ore.
(5) Hold remaining 83,409 ST of Fe Mn high carbon against reduction of ore value in desired inventory mix.

g. <u>Opium:</u> Hold 31,795 AMA lb of opium gum against 31,795 AMA lb of opium salt goal.

h. <u>Ricinoleic/Sebacic Acid Products:</u> Sebacic acid inventory is credited toward goal at the rate of 2.5 to 1.

i. <u>Tantalum Group:</u>

(1) Hold 201,133 lb Ta as Ta metal against 237,337 lb Ta as concentrates.
(2) Hold 28,688 lb Ta as Ta C against 33,852 lb Ta as concentrates.

j. <u>Tungsten Group:</u>

(1) WC powder goal is 2,000,000 lb W; stockpile grade inventory 1,921,167 lb W; shortfall 78,833 lb W. Hold 111,775 lb W as nonspecification grade WC to offset 78,243 lb W as WC specification grade (assume 70% recovery of usable W).

(2) W metal powder goal is 1,600,000 lb W; inventory stockpile grade 1,566,964 lb W; shortfall 33,036 lb W. Nonstockpile grade W metal powder inventory is 331,947 lb W. Assume 70% recovery as usable material, then 331,947 x .70 = 232,363 lb W. Hold 47,194 lb W as nonspecification grade powder to offset shortfall of 33,036 stockpile grade W powder.

(3) Hold balance of nonstockpile grade W powder 232,363 - 33,036 = 199,327 lb W as powder against 234,209 lb W as concentrate.

(4) Hold 840,752 lbs W as Fe W stockpile grade against 987,884 lb W as concentrate. Hold 1,184,609 lb W nonstockpile grade Fe W at 70 percent recoverable against 974,341 lb W concentrate.

Appendix B: U. S. Production, Consumption, and

Import Reliance on Strategic and Critical Minerals: 1982 (7:40-41)

Mineral/Metal (units)	Domestic Production	Apparent Consumption	Imports	Net Import Reliance (percent)
Antimony (s.t.)	13500	33200	14000	45
Asbestos (m.t.)	64	243	241	74
Bauxite/alumina (1000 m.t.)	700	3700	15700	97
Beryllium (s.t.)	W	328	108	W
Bismuth (s.t.)	W	1050	1700	90
Cadmium (m.t.)	1150	3715	2215	69
Chromium (1000 m.t.)	0	330	755	88
Cobalt (s.t.)	0	5500	6500	91
Columbium (s.t.)	small	3050	2725	100
Copper (1000 m.t.)	1160	1800	500	7
Diamond (1000 carats)	0	3200	4900	100
Fluorspar (1000 s.t.)	74	800	730	87
Graphite (1000 s.t.)	0	44	56	100
Iodine (s.t.)	W	3950	2750	W
Lead (1000 m.t.)	500	1065	110	1
Manganese (1000 s.t.)	0	700	265/620	99
Mercury (76 pound flasks)	25000	50700	8400	43
Mica (s.t.)	0	1800	1500	100
Nickel (s.t.)	3000	174000	130000	75
Platinum Group (1000 troy oz.)	6	2200	2500	85

Mineral/Metal (units)	Domestic Production	Apparent Consumption	Imports	Net Import Reliance (percent)
Quartz Crystal (s.t.)	125	NA	NA	NA
Talc (1000 s.t.)	1060	720	10	E
Tantalum (s.t.)	small	475	580	90
Thorium (s.t. ThO)	W	15	22	NA
Tin (m.t.)	2000	46000	31500	72
Titanium (s.t.)	18400	20000	1870	9
Tungsten (s.t.)	1600	7400	3900	14
Vanadium (s.t.)	5600	6500	1595	14
Zinc (1000 m.t.)	215	810	455	53

Notes:

a. Data derived from U. S. Bureau of Mines, Mineral Commodity Summaries 1983. Washington: Government Printing Office.

b. Apparent consumption includes recycled material.

c. Net import is the sum of imports minus exports plus adjustments for Government and industry stock changes and is expressed as a percentage of apparent consumption.

d. W = withheld by Bureau of Mines to avoid disclosing company proprietary data.

NA = Not available

E = Net exports

m.t. = Metric ton (1 metric ton is 2204 pounds)

s.t. = Short ton

Appendix C: Financing Methods Of Countries That Have Stockpiles (14:1-5)

Sweden

The Government of Sweden maintains raw material stockpiles of a large number of minerals. These stockpiles are intended for use in the event of a war or a blockade or disruption of supply lines in peacetime. These government stockpiles reportedly are supplemented by private sector stockpiles. The financing of the government stockpiles is discussed in the classified report we are furnishing under separate cover. The private sector stockpiles, however, have accrued as a result of the treatment of inventories under Swedish tax law.

Some analysts have described Swedish tax law as having the effect of encouraging higher levels of raw material inventories than would normally be the case because of provisions that apply to inventories. Taxable income is reduced by the amount allowed for inventory write-down which, under Swedish law, is very generous. The lower taxable income results in lower tax payments to the government, which in effect reduces the cost of raw material inventories.

Inventory valuation system. For tax purposes, the value of inventories is the lower of the purchase or replacement value; purchase value is determined on a first-in-first-out basis (FIFO). This value can be written down by any of the methods described below.

Basic rule. The value may be written down by a maximum of 60 percent after deducting either unmarketable or obsolete merchandise or 5 percent of the value, whichever is greater. This basic rule is waived by two supplementary rules.

Supplementary rules

1. If the net inventory value (value less unmarketable or obsolete items) has fallen below the average value of the inventories for the two immediately preceding years, the writeoff allowed is 60 percent of this average value.

a/ We used the International Monetary Fund conversion rates to obtain U.S. dollar equivalents; the average exchange rate for the period covered was used in each case.

2. To account for the risk of price declines in raw materials and commodities included in inventories, the writeoff allowed is the difference between the FIFO value and 70 percent of the lowest market value in the past 10 years; no other writeoffs are permitted when this rule is applied.

The following example illustrates the effect of these inventory valuation rules.

Given

ABC Corporation raw materials inventory account

	Swedish kronor
At December 31, 1979	800,000
At December 31, 1980	600,000
At December 31, 1981	500,000
Inventory at lowest market value in past 10 years	400,000
Unmarketable or obsolete items	30,000

Then, total writeoffs as of December 31, 1981 would be

Under basic rule:

Unmarketable items		a/ 30,000
Plus 60% of net inventory value		
Value of inventory	500,000	
Less unmarketable items	- 30,000	
Net inventory value	470,000	
Writeoff	X 60%	282,000
Total writeoff		312,000

Under first supplementary rule:

Inventory at December 31, 1979	800,000	
Plus Inventory at December 31, 1980	600,000	
Average of 2 years	1,400,000/2 =	b/ 700,000
		x 60%
Writeoff (60% of average of 2 past years' inventory)		420,000

Under second supplementary rule:

Inventory at December 31, 1981	500,000
Less 70% x 400,000 (10-year-low inventory)	280,000
Writeoff	220,000

a/ Greater than 5 percent of inventory value, which is 25,000.
b/ Higher than net inventory value, which is 470,000.

The full tax subsidy to inventories, however, may not be realized. In 1977, a Swedish embassy official indicated that more than 80 percent of Swedish companies do not fully use the inventory writeoffs because they need to give their shareholders yearly returns rather than using such funds for larger inventories.

We did not obtain any stockpiling cost figures for Sweden.

Switzerland

The system of strategic stockpiles in Switzerland has existed since after World War II on a compulsory and voluntary basis. Stockpiles are maintained by private firms and financed in part by Swiss Government funds. By September 1981, the stockpiles were valued at 10 to 12 billion Swiss francs (about $5 billion to $6 billion).

Compulsory stockpiling (i.e., stockpiling of critical goods which are essentially imported) is financed by means of a special import levy added to consumer prices. Voluntary stockpiling for essential raw materials, such as iron and steel, fuel rods, nonferrous metals, etc., is encouraged by (1) providing bank credits at favorable rates, with government guarantees, for up to 90 percent of the purchase value, (2) giving strategic inventories preferential national and local tax treatment, and (3) allowing the holder to retain ownership of 50 percent of the voluntary stockpiles in an emergency allocation.

France

The French Government completely controls its stockpile program. When the program started in 1975, the government, for economic as well as strategic reasons, preferred to finance the stockpile by issuing government-guaranteed bonds rather than using government appropriations or bank loans. Despite this preference, the initial purchases for the stockpile were funded directly when the government budgeted 250 million French francs ($55.4 million) to purchase raw materials in January 1975. An additional 169 million French francs ($37.4 million) was included in the budget submission in late 1980 for a variety of primary materials and related expenditures.

In July 1980, the government established the Caisse Francaise de Matieres Premieres (CFMP), or French Fund for Raw Materials, under the jurisdiction of the Ministry of Industry for the purpose of issuing and managing government bonds. The details of the stockpile are not made public by the French Government; however, a report prepared for the U.S. Department of Commerce in September 1981 mentioned that the CFMP has raised 500 million French francs ($89.8 million) since its establishment, by issuing 10-year bonds denominated at 5,000 francs ($898) each which pay 14 percent interest a year. According to some reports, in addition to this financing and despite earlier objections, bank loans were also used in financing the stockpile.

Japan

Japan's stockpiling program, which began in 1976, was created with economic considerations as the determining factor; a strategic stockpile is under consideration. The program was set up by the Ministry of International Trade and Industry (MITI) in cooperation with Japanese private industry.

To help finance the program, the Government of Japan has guaranteed bank loans and provided interest subsidies. During fiscal years 1976-81 the interest subsidies and authorized bank guarantees amounted to 3.2 billion yen ($14.4 million) and 178.2 billion yen ($779.2 million), respectively, as shown in tables 1 and 2).

Table 1

Interest Subsidies

Fiscal year	Yen	Dollars
	(millions)	
1976	369	$ 1.3
1977	738	3.1
1978	876	4.5
1979	680	2.8
1980	476	2.3
1981(authorized)	75	0.3
	3,214	$ 14.4

Table 2

Authorized Guarantees for City Bank Loans for Copper, Lead, Zinc, and Aluminum Stockpiles

Fiscal year	Yen	Dollars
	(millions)	
1976	30,000	$102.5
1977	30,000	125.0
1978	45,100	231.8
1979	44,700	186.5
1980	11,500	56.7
1981	16,900	76.9
	178,200	$779.2

The Japanese Government provides its financial assistance to the program through the Metal Mining Agency of Japan (MMAJ), under the overall guidance of MITI. MMAJ and the private sector mining companies run the program jointly through three specially created stockpiling associations.

1. The Metallic Minerals Stockpiling Association (MMSA), formed by 26 firms in the copper, lead, and zinc industries. It is financed by nominal member subscriptions, direct loans

from private banks without interest subsidies, and 3-year loans from MMAJ at 6.5 percent interest (for MITI-authorized purchases only); the government guarantees both types of loans.

MMAJ loans are funded by the Industrial Bank of Japan and 22 commercial banks at the banks' most favorable long-term interest rates (quoted at 9 percent). MMAJ's administrative expenses and interest subsidies (2.5 percent, or the difference between the long-term bank rate and the rate at which MMAJ makes loans) come from the general national budget.

2. The Light Metal Stockpiling Association (LMSA), formed by 18 firms in the aluminum industry. It is financed in the same way as MMSA. MITI was reported to be considering allocating about 5 billion yen ($19.4 million) in fiscal year 1982 to increase Japan's aluminum stockpile.

3. The Special Metals Stockpiling Association (SMSA), formed by about 30 companies, mostly in the steel industry. It has been financed by member subscriptions, initial contributions ($170,000) from the government's fiscal year 1976 budget, and a private foundation. In addition, in 1981 SMSA was expected to borrow 11.5 billion yen ($44.7 million), with government guarantees, from private and government banking agencies to finance the stockpiling program for nickel, cobalt, chromium, tungsten, and molybdenum. The government has also allocated 500 million yen ($1.9 million) to pay for two-thirds of the loan's interest expense.

Metal users were hoping the government would establish its own large stockpile instead of relying on private companies to raise inventory levels. Such a stockpile is said to be under consideration.

Appendix D: Interview Schedule

What is your job title? ______________________________

____

____

____

1. Privately owned and managed economic stockpiles have been suggested as one alternative to reducing U. S. vulnerability to the dependence on imported strategic and critical materials. Specifically, this type of stockpile would require holding a larger than normal working stock of materials dedicated solely to support DoD requirements. Does your company consider private economic stockpiling as an acceptable alternative to reduce vulnerability to possible reductions in or cessations of the imported material supply?

Yes______ No______

2. The following incentive programs could influence your company's decision to develop an economic stockpile dedicated solely to support DoD requirements. Rank the incentives from the most influential (Rank of 1) to the least influential (Rank of 7).

_____ Tax credit for materials held in excess of normal stock

_____ Interest and carrying cost rebates paid directly by the Federal Government

_____ Percentage of purchase cost rebates paid by the Federal Government

_____ Tax free interest on bonds floated to finance inventories in excess of normal

_____ Low interest loans

_____ Loan Guarantees

_____ Guaranteed DoD multi-year procurement contracts

Please provide any other incentive program not listed.

____

____

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____

3. What would be the most significant advantage or disadvantage to establishing private economic stockpiles?

Appendix E: Data For Chi Square Test

Acceptance of Economic Stockpiling	Observed (O_i)	Expected (E_i)	$\frac{(O_i - E_i)^2}{E_i}$
YES	9	16	3.0625
NO	17	10	4.9
SUM	26	26	7.9625

$$\chi^2 = \sum_{i=0}^{k} \frac{(O_i - E_i)^2}{E_i} \qquad (1)$$

Computed Chi Square = 7.9625

Degrees of Freedom (df) = k-1
= 2-1
= 1

Level of Significance = .05

Critical Value of $\chi^2_{1,.05}$ = 3.84

Results: Reject H_o

Appendix F: Incentive Rankings

Table V

Incentive Rankings - All Contractors

Contractor	Tax Credit	Int. Rebate Paid	Pur. Rebate Paid	Tax Free Bond Interest	Low Int. Loans	Loan Guar.	Multi Year Cont.
1.	3	1	2	6	5	7	4
2.	5	4	7	6	2	3	1
3.	3	1	4	5	2	7	6
4.	3	2	1	5	6	7	4
5.	4	2	5	6	3	7	1
6.	4	2	3	7	5	6	1
7.	5	1	3	2	6	7	4
8.	2	3	4	1	6	7	5
9.	2	1	3	4	6	7	5
10.	4.5	4.5	4.5	4.5	4.5	4.5	1
11.	3	4	2	5	6	7	1
12.	3	2	5.5	5.5	5.5	5.5	1
13.	3	2	5	4	6	7	1
14.	4	2	3	5	6	7	1
15.	3	4	2	5	6	7	1
16.	4	5	2	3	6	7	1
17.	2	4	3	7	6	5	1
18.	1	2	3	5	6	7	4

Table V (Continued)

Contractor	Tax Credit	Int. Rebate Paid	Pur. Rebate Paid	Tax Free Bond Interest	Low Int. Loans	Loan Guar.	Multi Year Cont.
19.	2	2	2	5	6	7	4
20.	1	2	6	5	3	7	4
21.	4	2	3	6	5	7	1
22.	5	2	5	5	5	5	1
R_j	70.5	54.5	78	107	112	141	53
$R_j - \frac{\Sigma R_j}{N}$	-17.5	-33.5	-10	19	24	53	-35
Ranking	3	2	4	5	6	7	1

Table VI

Incentive Rankings - Subgroup 1

Contractor	Tax Credit	Int. Rebate Paid	Pur. Rebate Paid	Tax Free Bond Interest	Low Int. Loans	Loan Guar.	Multi Year Cont.
1.	3	1	2	6	5	7	4
2.	5	4	7	6	2	3	1
3.	3	1	4	5	2	7	6
4.	4	2	3	7	5	6	1
5.	5	1	3	2	6	7	4
6.	3	2	5.5	5.5	5.5	5.5	1
7.	1	2	3	5	6	7	4
8.	4	2	3	6	5	7	1
9.	5	2	5	5	5	5	1
R_j	33	17	35.5	47.5	41.5	54.5	23
$R_j - \frac{\sum R_j}{N}$	-3	-19	-.5	11.5	5.5	18.5	-13
Ranking	3	1	4	6	5	7	2

Table VII

Incentive Rankings - Subgroup 2

Contractor	Tax Credit	Int. Rebate Paid	Pur. Rebate Paid	Tax Free Bond Interest	Low Int. Loans	Loan Guar.	Multi Year Cont.
1.	3	2	1	5	6	7	4
2.	4	2	5	6	3	7	1
3.	2	3	4	1	6	7	5
4.	2	1	3	4	6	7	5
5.	4.5	4.5	4.5	4.5	4.5	4.5	1
6.	3	4	2	5	6	7	1
7.	3	2	5	4	6	7	1
8.	4	2	3	5	6	7	1
9.	3	4	2	5	6	7	1
10.	4	5	2	3	6	7	1
11.	2	4	3	7	6	5	1
12.	2	2	2	5	6	7	4
13.	1	2	6	5	3	7	4
R_j	37.5	37.5	42.5	59.5	70.5	86.5	30
$R_j - \frac{\Sigma R_j}{N}$	-14.5	-14.5	-9.5	7.5	18.5	34.5	-22
Ranking	2.5	2.5	4	5	6	7	1

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VITA

Captain Robert K. Hutto was born on 12 December 1952 in San Antonio, Texas. He graduated from high school in Austin, Texas and attended the University of Texas where he received the degree of Bachelor of Business Administration in May 1975. From September 1975 through August 1977, he was employed as a Configuration Management Specialist with Tracor Incorporated in Austin. He received his commission in the USAF through Officer Training School in December 1977 and entered the Supply career field. Captain Hutto has served as the Materiel Storage and Distribution Officer for the 67th Tactical Fighter Wing, Cannon AFB, NM, as the Director of Logistics/MASO at TUSLOG Detachment 10, Turkey and as Director of Logistics at a classified location. He was supporting the 12th Flying Training Wing at Randolph AFB, Texas as the Material Management Officer until entering the School of Systems and Logistics, Air Force Institute of Technology, in May 1984.

Permanent address: 218 Driftwood

Granite Shoals, Texas 78654

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Air Force Institute of Technology (ATC)
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The defense industry and essential civilian industry of the United States has grown dangerously dependent on uncertain foreign sources of strategic and critical materials. The corresponding increase in vulnerability to shortages or cessations in supply has generated new interest in alternatives for reducing the vulnerability.

As prime users of many of the strategic and critical materials, 30 of the top 100 Department of Defense contractors for fiscal year 1984 were surveyed on their acceptance of creating privately owned and operated economic stockpiles as one alternative for reducing imported mineral vulnerability. The contractors were also asked to rank, in order of preference, seven possible financial incentive programs that might induce defense contractors to consider establishing private stockpiles of strategic and critical materials.

Results from personal interviews with Material Managers of the selected defense contractors shows that the private stockpiling alternative is not considered acceptable by the sample of contractors surveyed. The cost associated with developing and holding excess inventories was cited as the prohibitive factor.

Of the seven incentive programs offered, use of "guaranteed multi-year procurement contracts" was more influential to the contractors than were the direct financial incentives offered. Stabilized procurement and production planning was emphasized by the contractors.

Recommendations from this study are that Congress should not rely on the private stockpiling alternative as a means of reducing import vulnerability. Defense contractors would be much more receptive to establishing private stockpiles if Congress and the Department of Defense used guaranteed multi-year contracting in conjunction with one of the preferred incentive programs. The Department of Defense must emphasize to Congress the potential benefits in coupling long-range procurement with specific short-range investment incentives as a method of assuring availability of increasingly important strategic and critical materials.

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